



## **Automotive Electronics**

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June 23, 2005*

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### **Summary**

With an expected continuing increase in the amount of electronics used in cars, automotive electronics will continue to remain consistently strong in the German electronics market. Automotive electronics will once again be the largest group within the German electronics industry, with a growth rate of approximately 8.7% predicted for 2005.

One of the biggest changes seen recently is the increase in electronics in mid-range vehicles that had previously been used only in luxury cars. Consumers are now demanding options such as voice control, navigation, climate control and various multimedia functions. Demand for comfort and entertainment applications is growing strong.

The use of semiconductors in this segment must also not be underestimated: As automotive semiconductors have an annual average growth rate of 12%, with German production totaling USD 5.5 billion in 2004. Although growth rates are not as high as they used to be in the recent past, one area that has experienced growth is that of micro-controllers and semiconductor sensors. Semiconductor growth in the German market is expected to reach 9.9% in 2005 compared with 18.8% in 2004. Experts anticipate growth to slow down in other areas as well, such as are integrated circuits (ICs), electromechanical components, printed circuit boards (PCBs), and passive components.

As electronics will continue to play an increasingly important role in cars over the next few years, a key focus has been on product quality in order to both prevent and reduce technical errors in the earliest stages of production. The response to quality control has been positive so far, with a goal of 4-6 central control units per car in the future, aiming for better quality automotive electronic products.

Environmental laws and regulations influence decisions of many automotive electronic manufacturers. The German Electrical and Electronics Manufacturers Association (ZVEI) offers helpful "Umbrella Specifications" that guide producers through customer requirements and legal regulations in this matter. Emissions have been a main focus in this area.

### **2. Market Profile**

Electronics are increasingly enhancing automotive efficiency, performance, safety and convenience. With 33% of electronic components production going into the automotive industry, this sector is the user of electronic components in Germany. After a strong growth in 2003 of 25.3%, the automotive industry reached a market volume of USD 7.13 billion (+19.3%) in 2004. This is due to the fact that demand for automobile electronics, especially electronic data transmission systems and security-based

applications (ESP), has grown in demand. Applications formerly reserved for luxury cars are now being installed in mid-range cars, as well. A constantly increasing demand for electronics in automobiles (motor management, security, and infotainment, including telematics and comfort) is expected to guarantee growth in 2005 by nearly 9% to a total market of USD 7.76 billion.

The most important areas of application for innovative electronics are driver assistance systems, navigation, safety, multimedia/infotainment, human-to-machine interfaces, power trains, energy management and development tool systems.

The total semiconductor market (including sensors), at USD 4.02 billion, was by far the largest segment within the automotive electronics industry in 2004, accounting for 56% of the market. Experts project an increase of 9.9%, reaching USD 4.41 billion in 2005. A comparable market increase of 9.3% is projected for ICs, as well as 9.0% for the passive components segment. Although the IC segment has a rather small share within the automotive electronics market, the automotive sector accounted for 82.3% of all IC customers in 2004. Markets for connectors and switches, as well as for PCBs, are expected to continue their growth at a slightly elevated rate of 5.9% and 6.6%, respectively.

### 3. Market Trends

Due to the anticipated further increase of electronics in cars, this segment is expected to remain highly significant. Planned upgrades and innovations of existing functions within the fields of safety, emission, comfort, and entertainment will significantly determine future trends within the following application fields:

**Safety.** The main workings in the field of safety focus on surround sensing with different sensor systems (video, infrared, radar, and ultrasonic techniques), satellite navigation, enhancements in the areas of passenger protection, and the integration of security functions (the brake assistance system with the steering booster and/or belt pre-tension systems).

**Emission.** There is a perceivable trend toward energy efficient automobiles, which coincides with a movement to reduce damaging exhaust emissions. In the near future, intelligent, adaptable electromechanical couplings will replace the all-mechanical couplings. Thus, it should increase efficiency and enhance the operating range of the engine, the auxiliary aggregates and the gearboxes.

**Comfort and Entertainment.** The field of comfort and entertainment is one of the fastest-changing sectors. Mobile communication functions, voice control, navigation, climate control and air conditioning will be offered to drivers, while additional multimedia functions such as the use of videos and notebooks will be offered to passengers. At this stage, various manufacturers have approached the fields of voice control, bluetooth, and UMTS, yet have maintained their distinctive attributes. While the integration of functions constantly increases the amount of data being transmitted in cars, bus systems have increasingly set higher standards and requirements for bandwidth, reliability and security. Several bus systems have long been simultaneously fulfilling different functions (Can Bus, LIN Bus for easier control systems, and MOST and IEEE1394 for security-related functions).

Within the past few years, the usage of the OSEK/VDX-OS-standard operating system has significantly increased in the automotive industry, as most German car manufacturers have required from their suppliers to use it. BMW, for example, has been using the OSEK operating system, a feature of the CORE-standard based products.

Trends affecting electronic device manufacturers:

**Long-term Maintenance.** Product cycles of consumer goods are considerably shorter compared to those of automotive electronics products, which demand long-term adjustable, upward-compatible connections. Furthermore, operation and maintenance of assembly lines are costly to manage, particularly for worldwide operating manufacturers.

**Quality.** Quality requirements have significantly increased within the past two decades, especially with respect to usage and functionality. If the share of electronic components in cars increases as anticipated, then the technological errors, which occur frequently during developmental stages, will need to be reduced. Both, centralization and the reduction of control units are key elements to the reduction of errors. With this in mind, the automobile industry aims at about 4-6 central control units per car in the near future.

**Environmental Laws.** Aside from increasing customer demands, legal and regulatory standards constantly affect entrepreneurial decision-making processes. For example, the industry is working on a replacement of mechanical couplings by intelligent, adaptable, electromechanical couplings to increase efficiency, reduce emission, and, ultimately, meet new regulations imposed by the European legislation.

#### 4. Import Market

German Market for Automotive Electronics by Product Groups (in USD billion) \*

	Total Automotive Electronic Components Market			Total Semiconductors (incl. Sensors)			Integrated Circuits (ICs)			Connectors and Switches			Printed Circuit Boards (PCBs)			Passive Components		
	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
Market Size (USD billion)	5.98	7.13	7.76	3.38	4.02	4.41	0.42	0.62	0.67	1.23	1.40	1.49	0.44	0.50	0.53	0.51	0.60	0.65
Market Growth (%)	25.3	19.3	8.7	26.7	18.8	9.9	23.3	48.2	9.3	19.5	13.9	5.9	33.8	14.3	6.6	25.3	16.8	9.0
Market Allocation (%)	33.4	33.0	33.6	29.4	28.4	29.0	77.6	82.3	82.7	43.4	42.8	42.8	28.0	28.0	28.0	34.5	36.5	38.5
Exchange Rate EUR/USD	1.13	1.25	1.30	1.13	1.25	1.30	1.13	1.25	1.30	1.13	1.25	1.30	1.13	1.25	1.30	1.13	1.25	1.30

Source: German Electrical and Electronics Manufacturers Association (ZVEI)

(\*Export/import figures are only available for the total electronic components industry but not for individual industry segments)

All segments are predicted to grow for by an average 8.7% in 2005, with conductors and switches increasing by 5.9%, total semiconductors by 9.9%. Although the automotive electronics market witnessed 19.3% growth in 2004, a predicted decelerated growth to 8.7% will still be a significant contributor to Germany's GDP growth rate in 2005, which is projected to be between 1.0 and 1.5%.

**Semiconductors.** Automotive semiconductors have an annual average growth rate of 12% and make up 17% of the world market. German production accounts for an impressive 30% (2004: USD 5.5 billion) of the European total. Microcontrollers and semiconductor sensors, in particular, are selling very well, profiting from strong developments and outstanding prospects for the future. In recent years, nearly a third

of all semiconductors have been used in the automotive electronic components industry. The 2003 growth rate of 26.7% for semiconductors resulted in revenues of USD 3.38 billion. Decelerating to a 18.8% growth rate it reached a market size of USD 4.02 billion in 2004. In 2005, a projected growth rate of 9.9% will result in estimated revenues of USD 4.41 billion. Within the semiconductor segment, sensors are expected to reach USD 700 million in 2005, (down 5.9% and USD 90 million from 2004, as compared to a growth rate of 14.8% in 2004). 87.1% of all sensors were used in the automotive electronic components industry in 2004, down 1.0% from 2003.

**Integrated Circuits (ICs).** Following an accelerated growth rate of 48.2% in 2004, revenues for the IC segment peaked at USD 620 million in Germany. 2005 is predicted to witness a sharp deceleration to 9.3% in the growth rate for ICs, compared to 2004, with a slight increase in revenues to USD 670 million (+ USD 50 million). In 2004, 82.3% of revenue from the total IC market could be attributed to the automotive electronic components industry, for 2005 82.7% are forecast in 2005.

**Electromechanical Components.** The second largest segment within the automotive electronic component industry experienced a 13.9% increase to USD 1.4 billion in 2004. Market growth is predicted to decelerate to 5.9% in 2005, however, resulting in USD 1.49 billion in revenue.

**Printed Circuit Boards (PCBs).** The PCBs segment reached a market volume of USD 500 million in 2004, a decelerated growth rate of 14.3% compared to an impressive market growth of 33.8% in 2003. Trends predict that the growth rate will continue to decelerate to a rate of 6.6% in 2005, with revenue expected to reach USD 530 million.

**Passive Components.** With a comparably moderate market growth of 16.8%, passive components peaked at USD 600 million in 2004, following a more significant increase (+25.3%) in 2003. Revenue growth is expected to decelerate to 9.0% in 2005. The predicted revenue for 2005 is USD 650 million, equaling 38.5% of the total revenue for passive components.

## 5. Competitive Situation

Official facts and figures are not available for this particular market segment. The following content is based on individual research and reliable industrial and corporate relations: All leading U.S. automotive electronic components manufacturers (ANALOG Devices, Cherry, Lear Corporation, National Semiconductors, ON Semiconductors, Texas Instruments, Tyco Electronics, Vishay, etc.) are represented in Germany, either through their own subsidiaries or are represented by German distributors. Leading German and international automotive components manufacturers (Bosch, EPCOS, Infineon, etc., and Philips, Matsushita Electronics, RENESAS, etc., respectively) are also very well represented in this growing and highly competitive market segment. However, within the two designated areas of operation, safety and environment, as well as comfort and entertainment, it is German and American global players who dominate strongly. When it comes to product program and product range, there are certain significant differences in approaching the market and its customers. Whereas the German company, Bosch, the world's biggest independent supplier of car equipment, predominantly focuses on single components (semiconductors, sensors, etc.), ECUs and driver-assistance systems, the Dutch Philips Semiconductor subsidiary focuses on moving rapidly towards single, integrated electronic systems. Another approach among smaller competitors (AMI Semiconductors) is to collaborate directly with car manufacturers and bring their expertise to several task forces and automotive standards committees worldwide. Four of Germany's well-known automotive electronics manufacturers (AB Elektronik, Bosch, Infineon, PREH-Werke) operate within the areas of power management as well as safety and environment, providing single components such as semiconductors, sensors and

control switches. Non-German suppliers, on the other hand, tend to manufacture and provide ICs (National Semiconductors, ON Semiconductors), system solutions (Philips, RENESAS) and complete automotive systems (Lear Corporation), rather than single components.

The following chart outlines major players represented in the German automotive electronics market assigned to their respective areas of operation:

	Main Areas of Operation		
	Safety & Environment, Power Management	Comfort & Entertainment	Other
Companies represented	AB Elektronik (D)	Cherry (US)	Nat. Semiconductors (US)
	AMI Semiconductor (US)	AMI Semiconductor (US)	Kaschke KG (D)
	ANALOG Devices (US)	ANALOG Devices (US)	Lear Corporation (US)
	Bosch (D)	EPCOS AG (D)	Mentor Graphics (US)
	Cherry (US)	Infineon (D)	ON Semiconductor (US)
	EPCOS AG (D)	Matsushita Electric (JAP)	
	Infineon (D)	Nat. Semiconductors (US)	
	ON Semiconductor (US)	ON Semiconductor (US)	
	Philips (NL)	Philips (NL)	
	PREH-Werke (D)	PREH-Werke (D)	
	RENESAS (JAP)		
	Texas Instruments (US)		
	Tyco Electronics (US)		
	Vishay Intertech. (US)		

Source: Individual research

## 6. End-Users

For the specific segments within electronic components, the following end-user groups can be identified:

**Semiconductors.** The use of electronic semiconductors in cars will increase in the short-term and long-term by a conservative 4% to an optimistic 9% per year. When it comes to technical challenges, additional usage requirements (voltage, temperature, robustness, EMV, etc.) and quality assurance, requirements need to be addressed already in the design and development processes, (chip design/CMOS-processes). Moreover, micro -system-related technologies such as sensor technologies and evaluation electronics will penetrate the automotive industry and its components to an increasing degree.

**Passive Components.** As for passive components, the quantity of tantalum condensers produced has been constantly increasing within the last years. Customer requirements concerning volume efficiency and quality have been rising disproportionately at the same time. In older cars, sensor technology and electronics had been manufactured and used separately. Today, they are made in conjunction with evaluation electronics as one module placed at the measuring point. While high temperatures and gradients connected with humidity and vibrations worsen conditions for electrical components, they remain reliable and durable. Examples for market opportunities for passive components include:

- Bus Systems: Operating bus systems are increasingly making use of several applications in the areas of comfort electronics and in the interior.
- DC/DC-Converters: DC/DC -Converters, which are mostly customized, are constantly increasing in number of modules and will be incorporated more frequently.

- Antennae Systems: Inductive resistors are often indispensable when it comes to using radio-controlled applications such as keyless entry or tire pressure sensors.
- Radar Technology: As new driver-assistance systems are being developed and planned, several sensors are necessary to detect moving and firm obstacles.
- X-By-Wire: X-By-Wire systems will be electrically designed in the future, which will require additional inductive resistors for high operational current.

**Electromechanical Components and Assemblies.** Radio and remote control are standard applications in cars, mobile phones, navigation, and fully equipped multi-media based command centers. In this context, the increasing comfort and safety standards are pushing a significant trend towards a further isolation of entering commands, which are carried out by contactors, sensing devices or screen pads, and executing commands, which are carried out by motors or miscellaneous electromechanical systems. The technology to be integrated in future cars (Bluetooth, UMTS, digital entertainment electronics, optical data communication based on plastic fiber, radar control, etc.) widely corresponds to the technology used in the entertainment industries, particularly in the infotainment sector.

## 7. Market Access

The import climate for electronic components in Germany is very good. No import duties are levied on electronic components, with the exception of several types of electron tubes. Imports from EU or EFTA countries enter the German market duty-free. An import-turnover tax is applied but is passed on to the final consumer as a value-added tax (VAT). VAT in Germany is currently 16% and applies equally to European and German competitors. A general overview of customs issues can also be obtained by visiting the following web page: [www.export.gov](http://www.export.gov) (TIC Trade Information Center, U.S. Department of Commerce).

**Standards Requirements.** In order to be utilized or marketed in Germany, electronic components must first satisfy safety and technical DIN (Deutsche Industrie Norm) standards. A list of standards and testing procedures can be ordered from the publisher of the German Industry Standards Committee: Beuth Verlag GmbH (Beuth Publishing), ([www.din.de/din-normen](http://www.din.de/din-normen)). Underwriters Laboratories, Inc. (UL) ([www.ul.com](http://www.ul.com)) also assists U.S. manufacturers and exporters in understanding international standards, certification requirements, and compliance procedures. UL has agreements with a number of foreign agencies to conduct product testing and factory evaluations. A U.S. Government contact for foreign standards information is the National Institute of Standards and Technology ([www.nist.gov](http://www.nist.gov)). Detailed information including the TÜV is also available in the Country Commercial Guide ([www.export.gov](http://www.export.gov)).

**Environmental Specifications.** There has been a dramatic increase in the number and complexity of inquiries concerning substances and materials used in electronic components and sub-assemblies. The ZVEI offers the so-called "Umbrella Specifications" as a tool for efficiently processing customer requirements and legal regulations. The method is based on an intelligent grouping of all products in similar packages under one "umbrella." Details on the Umbrella Specifications are available from [Guidelines and Forms Version 2.1](#), published on the ZVEI webpage ([www.zvei.de](http://www.zvei.de)).

## 8. Market Entry

**Distribution/Business Practices.** For U.S. suppliers attempting to enter this market, it is crucial to: (A) adjust U.S. products to meet European technical specifications, (B) be prepared to make concessions to European design expectations, (C) adapt U.S. products to European quality standards, and (D) rigidly adhere to negotiated terms of delivery. It is extremely important that U.S. manufacturers and suppliers assist with end-user

applications, engineering and subsequent servicing, offer training courses for programming, operation, and maintenance, and provide software support. U.S. manufacturers and exporters need a competent local agent, distributor or representative, unless they plan to open their own branch office or subsidiary. The distribution method is changing from exclusive distribution rights to distribution by several specialized firms resulting in increased competition. There are about 370 distributors active in the German automotive electronics market. The minimum contract duration should be one year. A contract will be automatically renewed for the same period.

**Financing.** The minimum distributor discount is 25%, which covers storage and marketing costs. In representation agreements the German company is usually granted a 5% discount from the export list price. Price quotations also usually provide for payment within 30 days. A 2% to 3% cash discount is commonly granted for payment received within ten days. Scientific institutions, universities and other public agencies often obtain the customary German 10% "Public Agency Discount" (Behördenrabatt).

**Media Links.** Advertising in trade journals is an effective means of entering the German market. The "Electro and Electronics Buyers' Guide" (available in English) is published by the ZVEI and can be ordered on CD-ROM ([www.sachon-zvei-elektro-einkaufsfuehrer.de](http://www.sachon-zvei-elektro-einkaufsfuehrer.de)). There are also numerous magazines in Germany reporting on the electronics industry. The addresses of some of the more important magazines, all of which are published in German, are: [Automobil Elektronik](#), [D & V](#), [automotive](#), [Design & Elektronik](#), [ElektronikPraxis](#), [Elektronik](#), [Elektronik Industrie](#), [Markt&Technik](#), [Power Systems Design Europe](#)

## 9. Opportunities for Profile Building

The ZVEI, as well as sector-specific associations, industry-specific magazines, and research institutes, frequently organize workshops and conferences around certain central topics of interest. Mostly provided within the framework of important trade fairs, they present excellent networking opportunities for products and services exporters. Further information can be obtained from [www.euroforum.de](http://www.euroforum.de), [www.iis.fraunhofer.de](http://www.iis.fraunhofer.de), as well as from the websites listed in paragraphs 10 and 11.

## 10. Key Contacts

German Electrical and Electronics Manufacturers Association (ZVEI), [www.zvei-be.org](http://www.zvei-be.org), Association for Electrical, Electronic & Information Technologies (VDE), [www.vde.com](http://www.vde.com), AMA Association for Sensor Technology, [www.ama-sensorik.de](http://www.ama-sensorik.de).

## 11. Upcoming Trade Shows

Embedded World 2006, Feb 14-16, 2006, Nuremberg, [www.embedded-world-2006.de](http://www.embedded-world-2006.de)  
European Automotive Components Expo 2006, May 9-11, 2006, Stuttgart, [www.testing-expo.com](http://www.testing-expo.com)

Sensor 2006, May 30-June 1, 2006, Nuremberg, [www.sensorfairs.de](http://www.sensorfairs.de)

Electronica 2006, November 14-17, 2006, Munich, [www.global-electronics.net](http://www.global-electronics.net)

## For More Information

The U.S. Commercial Service Germany can be contacted via e-mail at: [munich.office.box@mail.doc.gov](mailto:munich.office.box@mail.doc.gov), website: <http://www.buyusa.gov/germany/en/>.

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